LH_2 Bearing Test Program Started at Marshall Space Flight Center

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A bearing test rig capable of running liquid hydrogen as the coolant has been installed in the hazardous test area at the MSFC. This test rig expands the testing capabilities at MSFC to include cryogenic bearings running in fuel turbopumps. This tester is a follow-on to the successful liquid oxygen bearing test program known as the bearing seals and materials tester (BSMT) program.

This particular rig is a compact, easy to assemble and disassemble tester. Typical turnaround times are 3 to 5 days to change a configuration. No special tools are required for working on the test rig. This tester is very versatile; it can be built with rolling element (ball or roller) bearings or fluid film (hydrostatic, foil, hydrodynamic) bearings in its internal positions. Presently, the unit is being used to evaluate ball bearings for a NASA liquid hydrogen turbopump. Currently, there are two rolling element bearings mounted in the reaction and load positions, and a hydrostatic bearing in the 'slave' or lower position.

The test unit is approximately 2-ft high, 18-in in diameter, and weighs 850 lb. The tester housing and internal parts are made of Inconel for use in cryogenic applications. The housing is rated for 2,000-lb/in^2 internal pressures. The shaft is driven by a GN^2 gas turbine. The test rig is not limited to testing using liquid hydrogen, but has been designed to accommodate almost any process fluid including, liquid oxygen, liquid nitrogen, rocket propellant (kerosene), or jet engine fuel. The bearings are pressure-fed propellant by a 5,000-gal tank through a system of control valves. Flow rates are determined by calibrated orifices in the supply lines. Speeds over 60,000 r/min are possible. Condition monitoring is performed by pressure transducers and temperature sensors internal to the test rig. Facility measurements are used to control the inlet and outlet parameters.

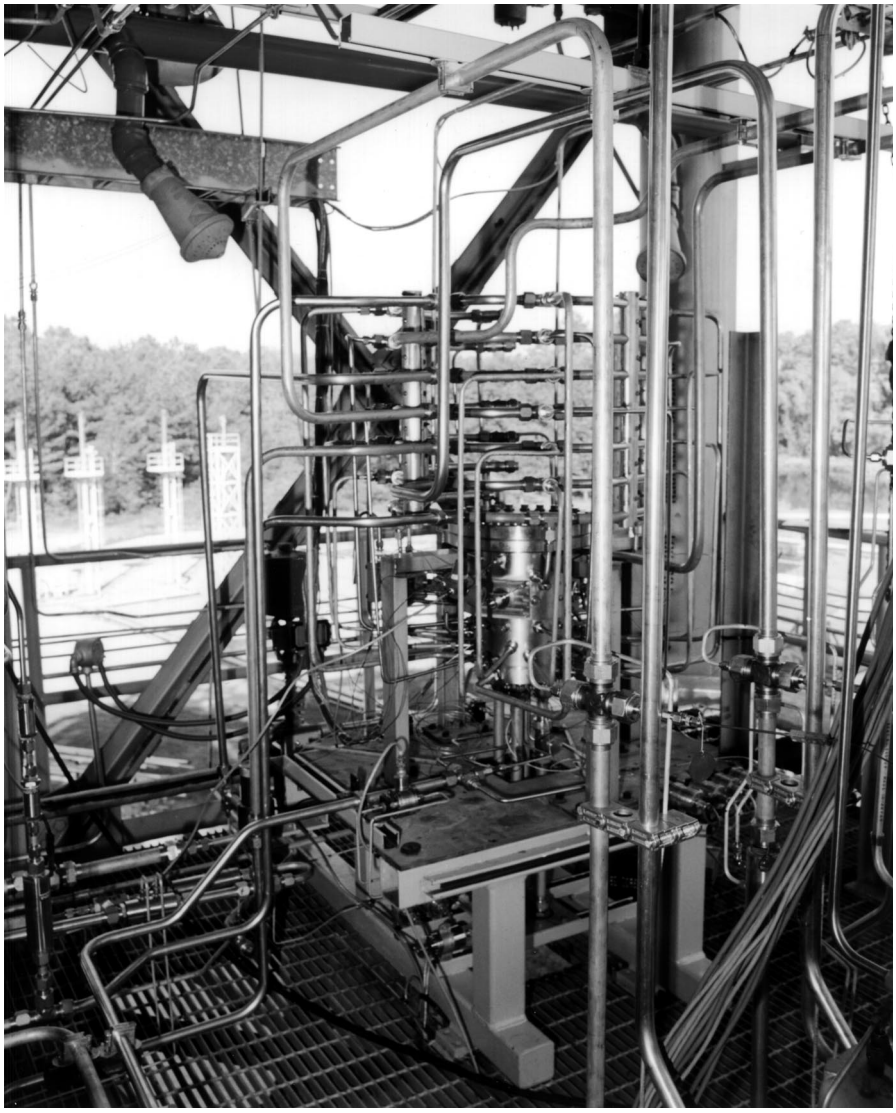

FIGURE 035a.—Bearing seal test facility located at Test Stand 500 second level.

The tester and control systems are fully operational. Currently, silicon nitride balls are being evaluated. Other bearing materials can be used such as 440C, 9310, and Cronidur 30. When built with hydrostatic bearings, design changes such as pocket size and shape, anti-wear coatings, and rotordynamic response can be studied.

With this test rig, MSFC has moved ahead into the area of evaluating advanced bearing technology for future space propulsion systems. This test rig is available for use by other Government agencies or industry through the use of NASA space act agreements.

Sponsor: Space Shuttle Main Engine Project Office

Biographical Sketch: Howard Gibson is a mechanical engineer with NASA's Materials and Processes Laboratory at Marshall Space Flight Center. His fields of expertise include mechanical design, hydraulics, pneumatics, industrial electrical controls, lubrication systems, and bearing design. He holds a degree in mechanical engineering from the University of Alabama.